NASA Facts

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HST and Women's Health:
NASA Technology in Your Doctor's Office

A new, nonsurgical and much less traumatic breast biopsy technique, based on technology developed for NASA's Hubble Space Telescope (HST), is now saving women time, pain, scarring, radiation exposure and money.

Radiologists predict that the new technique — known as stereotactic large-core needle biopsy — will reduce national health care costs by approximately $1 billion annually. The new technique is replacing surgical biopsy as the technique of choice, in many cases. Performed with a needle instead of a scalpel, it leaves a small puncture wound rather than a large scar. The patient is conscious under local anesthesia compared to being unconscious in surgery.

The new technique involves a NASA-driven improvement to the digital imaging technology known as a Charge Coupled Device or CCD. CCDs are high tech silicon chips which, unlike photographic film, convert light directly into an electronic or digital image. This image can be manipulated and enhanced by computers. For the last ten years, CCDs have been almost routinely used to observe stars, galaxies, and other astronomical objects in visible and ultraviolet light.

In the breast imaging system, a special phosphor enables the new CCD to convert X-rays to visible light, allowing the system to "see" with X-ray vision. The thin and highly sensitive CCD — which was not commercially available prior to Hubble's development — is now leading the field of digital breast imaging technology.

Technology from NASA's Hubble Space Telescope has been incorporated into the LORAD Stereo Guide™ Breast Biopsy System, as shown here, which offers women a quick, easy, and less painful method for determining if a breast lump is malignant.

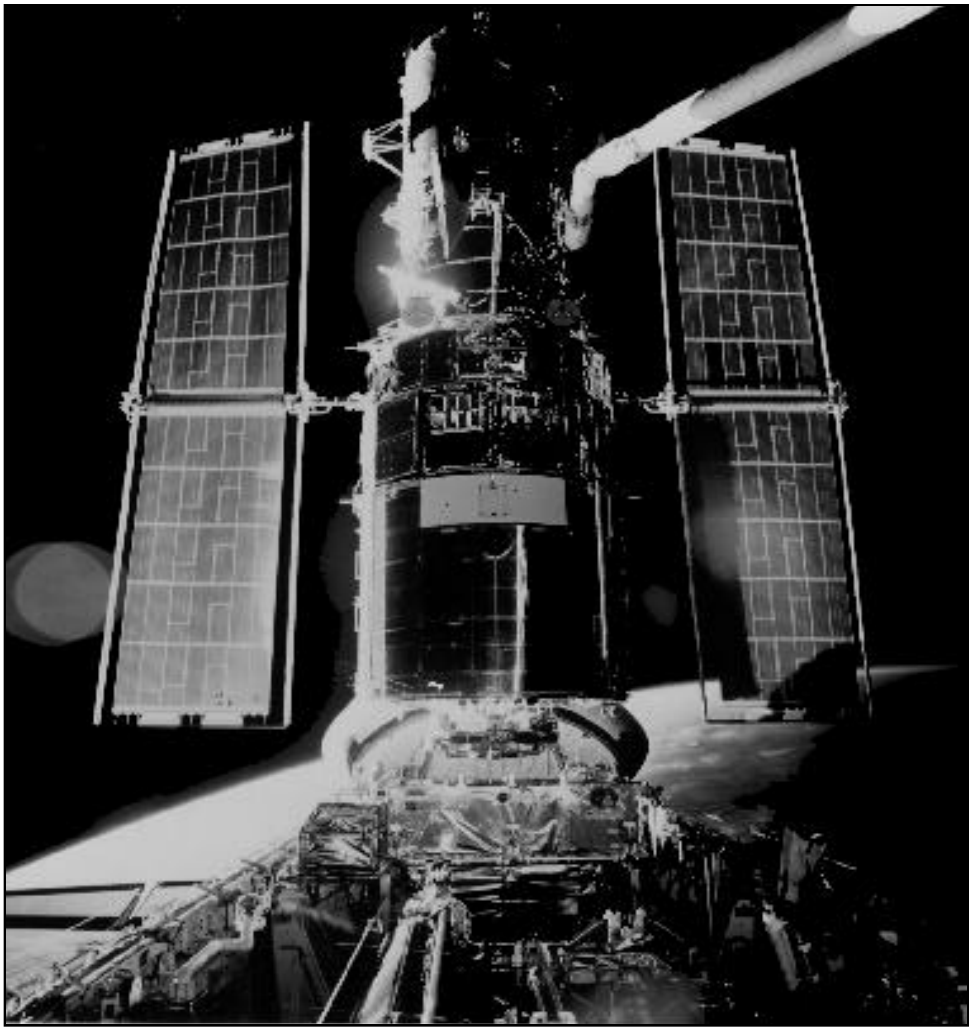
Dr. David Dershaw, Director of Breast Imaging at Memorial Sloan-Kettering Cancer Center in New York has been quoted as saying "The woman who has gone through a needle localization procedure and formal surgical biopsy on a prior occasion and now comes in to have the same thing done, but has it done as a stereotactic biopsy, is about the most appreciative patient you can imagine, because you've taken a long, drawn-out, anxiety-ridden and expensive event and made it shorter, easier to schedule, more comfortable. She has no surgical wound."

The technology breakthrough came when scientists at NASA's Goddard Space Flight Center in Greenbelt, Maryland developed the Space Telescope Imaging Spectrograph (STIS) — due to be installed on Hubble in 1997 during its next servicing mission — and realized that existing CCD technology could not meet the instrument's demanding scientific requirements.

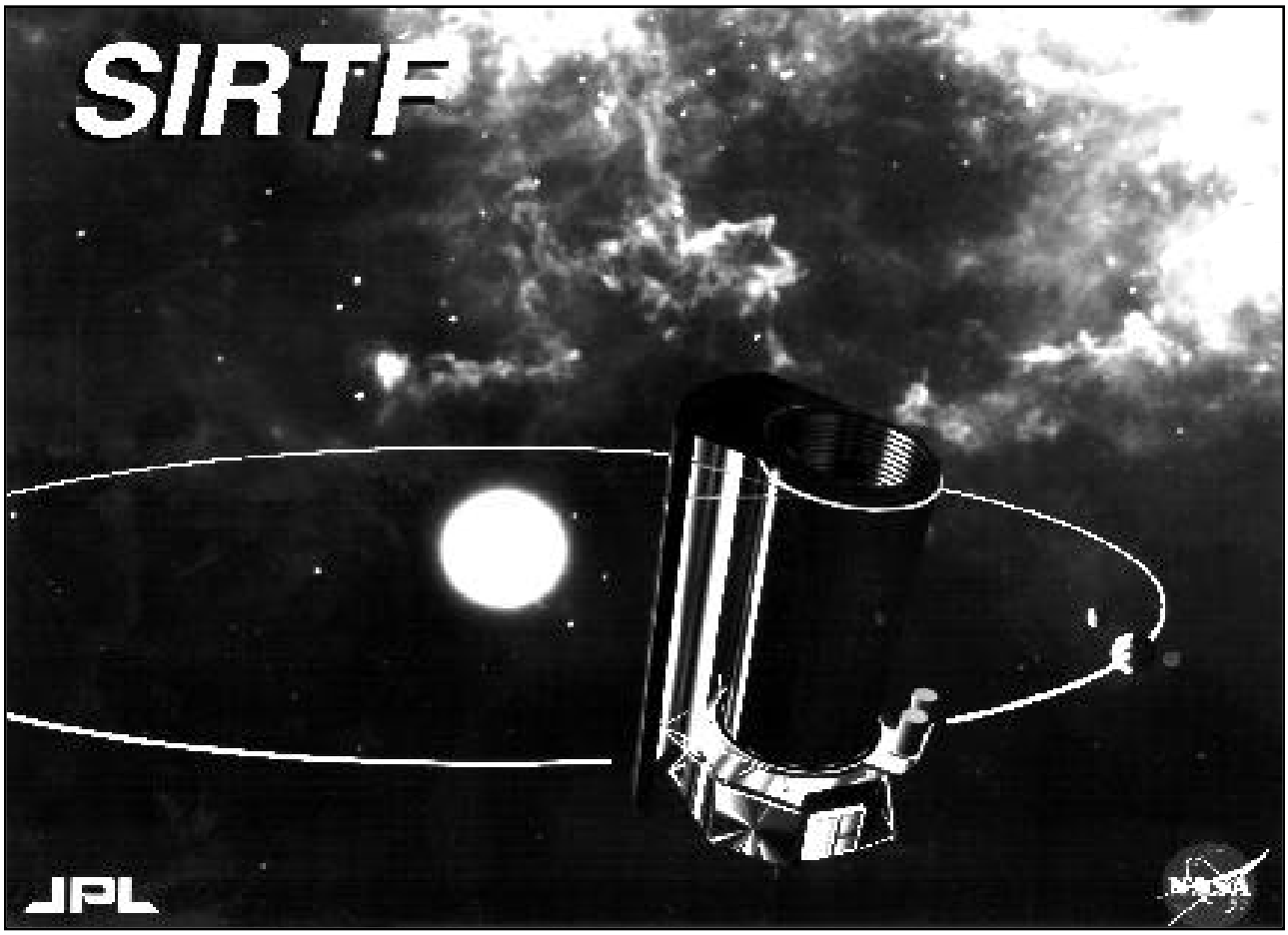
NASA contracted with Scientific Imaging Technologies, Inc., (SITe), of Beaverton, Ore., to develop a more sensitive CCD and lower manufacturing costs. After meeting NASA's rigorous scientific and space flight requirements, the company then applied its new knowledge to manufacturing CCDs for the digital spot mammography market. The result is a device that images suspicious breast tissue more clearly and efficiently than is possible with conventional X-ray film screen technology.

What made the transfer of knowledge possible was the common imaging requirements of both astronomy and mammography: high resolution to see fine details, wide dynamic range to capture in a single image structure spanning many levels of brightness, and low light sensitivity to shorten exposures and reduce X-ray dosage.

Site's CCD for digital breast imaging is virtually identical to the CCD developed for hubble. Nationally,



NASA's Hubble Space Telescope (shown here attached to the Shuttle's robotic arm during the first serving mis - sion in December 1993) was launched in 1990 with a 15-year expected lifetime. It is designed to be serviced by Shuttle astronauts about every 3 years. HST's next gener - ation of science instruments will be placed onboard in early 1997, dur - ing the second HST servicing mission.



Artist's concept of the Space Infrared Telescope (SIRTF), NASA's planned mission to study the universe in infrared wavelengths. SIRTF will be the next major NASA spacecraft to take full advantage of the infrared charge-coupled devices developed for the Hubble Space Telescope.

more than 350 digital breast imaging units containing SITe's thinned CCD already are in use by LORAD Corp., which uses the STIS-like CCDs in its breast imaging equipment, and many more are on order. Digital breast imaging is most often associated with stereotactic biopsies, but full digital breast units are becoming more widely available for routine mammographies.

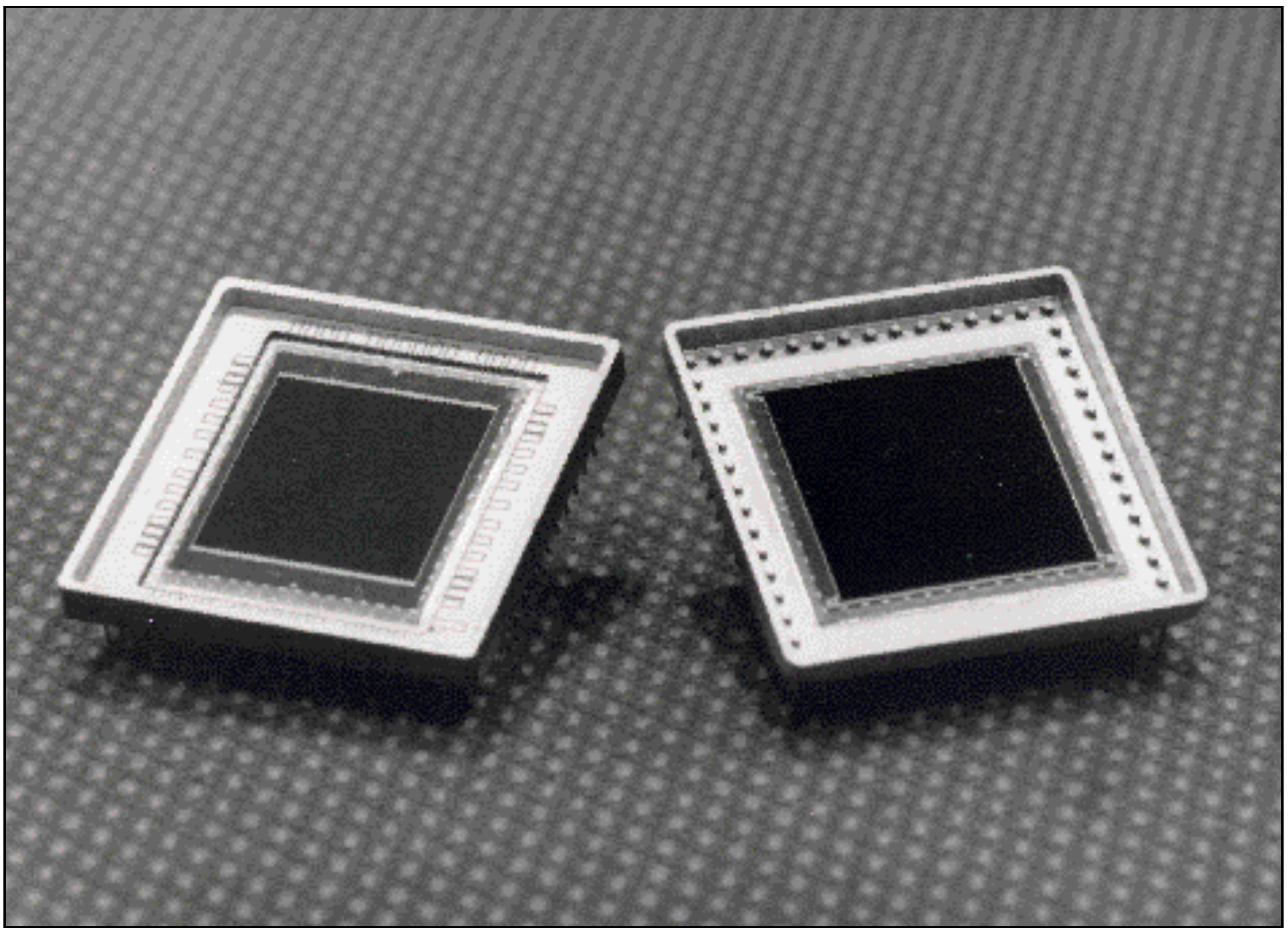
In the new nonsurgical technique, the CCD is part of a digital camera system that "sees" the suspicious breast tissue. A needle extracts the tissue. The patient lies face down with one breast protruding through an opening in a specially designed table. The imaging device and needle are mounted under the table (see picture on cover page).

The radiologist locates the suspected abnormality with the stereotactic X-ray imaging device by taking images of the suspected mass from two different angles. The computer finds the coordinates of the abnormality based on those two images, and the radiologist extracts a tiny sample of it with the needle. The tiny puncture wound is covered with minutes after the procedure and resume normal activities.

More than 500,000 American women undergo breast biopsies each year. While 80 percent of the suspicious masses are benign, this cannot be determined without a biopsy.

The traditional surgical technique involves running a guide wire into the breast to pinpoint the mass, surgically following the wire and digging into the breast to extract a tissue sample. With the traditional surgical biopsy, recuperation is about one week and involves a significant amount of pain, suturing and scarring.

Studies show that the new procedure is just as effective as traditional surgery. While traditional surgery costs about $3,500, core biopsy runs about



One of the thinned CCD's that will be used for HST's next generation of advanced infrared instruments (left) is compared to a CCD that has been adapted for use in breast biopsy pro - cedures (right). Nearly identical, each CCD is about 1 inch by 1 inch.

$850. Sampling suspicious tissue now can be done in a radiologist's office.

Although stereotactic location is also possible with X-ray film technique, radiologists say the new digital imaging device exposes patients to only half the radiation of the conventional X-ray film method. Unlike the X-ray film method, which radiates the entire breast, digital imaging exposes only a small portion of the breast to radiation. Also unlike X-ray film, which holds "frozen" pictures, digital images can be computer-enhanced to sharpen details. No film or plates need be processed, allowing patients to be evaluated almost immediately after the procedure.

The digital images, which are stored on computer disks, may be downloaded instantly to distant experts via computer networks, cellular signals or satellites. The digital image acquisition is almost foolproof virtually eliminating retakes and additional radiaton exposure.

The image quality is much better because the signal-to-noise ratio is better with CCDs. You don't get the granularity that is normally associated with x-ray film. In addition, taking pictures, developing the film and locating the coordinates of the abnormal tissue mass typically takes about fifteen to twenty minutes, and during this time, the patient — still at the machine — cannot move. Now, in near real time, the entire process of locating the suspected abnormality can take as little as five minutes and is much more comfortable for the patient.

The new biopsy technique, made possible by the CCDs developed for Hubble Space Telescope, will spare millions of women pain, scars and radiation exposure, will lead to much faster recuperation and will save billions in health care costs.